

DOCUMENT RESUME

ED 344 760

SE 052 725

TITLE Science: Grade 1. Interim Guide.
INSTITUTION Manitoba Dept. of Education and Training,
Winnipeg.
REPORT NO ISBN-0-7711-1006-5
PUB DATE 91
NOTE 10lp.; For other individual guides, Kindergarten
through Grade 9, see SE 052 724-733.
PUB TYPE Guides - Non-Classroom Use (055) -- Tests/Evaluation
Instruments (160)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Animals; Classroom Environment; Curriculum Guides;
*Elementary School Science; Foreign Countries; *Grade
1; Matter; Primary Education; *Process Education;
Science Activities; Science Instruction; *Scientific
Concepts; Student Attitudes
IDENTIFIERS Concept Maps; Manitoba; *Scope and Sequence

ABSTRACT

This guide is one of a set of 10 science guides, each covering a separate grade in Manitoba, together covering kindergarten through grade 9. The guides have been designed to provide a framework for building scientific concepts and developing the learning of process skills. They replace an earlier set of guides dated 1979. Each guide is essentially the same through the first 16 pages, after which the core units vary appropriately for each academic level. Three themes and units within those themes which are carried through the K-4 program include: (1) environmental interdependency and interaction--animals are living organisms/people are living organisms (grade 1); (2) matter and energy--properties of matter (grade 1); and (3) earth, time and space--comparing and measuring events (grade 1).
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Manitoba
Education
and Training



1991

science: grade 1

interim guide

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science: grade 1

interim guide

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manitoba education and training

1991

ISBN 0-7711-1006-5

This guide has been prepared by Manitoba Education and Training to meet the needs of grade 1 students. This guide has been revised on the basis of feedback from teachers during the period of 1988-89. It has been designed to articulate with the new kindergarten and 2-9 Science guides and to provide a framework for building scientific concepts and developing the learning of process skills. This guide may be used in September, 1991, in place of the previous (1979) guide.

The Department of Education and Training wishes to acknowledge the contributions of the following members who constituted the committees responsible for the development of this guide.

ACKNOWLEDGEMENTS

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Appreciation is extended to the following teachers who participated in piloting the program:

Grade 1

- G. Bellamy, River East School Division #9
- J. Bridgeman, Pelly Trail School Division #37
- M. Field, Birdtail School Division #38
- N. Pan, Winnipeg School Division #1
- L. Rhondeau, Agassiz School Division #13

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OBJECTIVES OF THE CURRICULUM

AIMS

"Science is a search for understanding" through a systematic and cumulative exploration of the natural phenomena of the universe.¹

Teachers should strive for balance in the science program, and should especially try to make processes development at least as important as content.

The K-4 science program includes the following:

- . promoting of attitudes as part of scientific literacy, including:
 - curiosity to explore, ask questions, actively investigate;
 - inventiveness in generating new ideas, using equipment constructively, suggesting new experiments;
 - critical thinking to justify conclusions or predictions and changing ideas in response to evidence or logical reasons;
 - persistence in maintaining an active interest in a problem.
- . understanding and use of scientific processes.
- . understanding and applying knowledge to practical situations.
- . understanding the interactions of science, technology and society by applying them to their environment.

¹ H. Grunau, Faculty of Education, University of Manitoba.

Science education provides experiences that are relevant to children on an immediate and personal level, developing attitudes, skills and knowledge for use today and in the future.

Exploration of the above areas, and helping children to apply the ideas in practical situations, provide for use of higher level thinking processes, which in turn provide for self-motivated, independent, concerned participants in society.

ROLE OF SCIENCE IN GENERAL EDUCATION

Children initially examine their environment through concrete experiences within a broad range of interests. One of the important functions science shares with other areas of study is the development of basic processes of classifying, measuring, using space-time relationships, inferring and predicting, and applying these processes to the world around them.

The young child lives in and views an integrated world and this leads to many opportunities for integrating subject areas.

Through interaction with materials in simple group activities, children are able to develop listening, reasoning, and group participation skills. In centre based activities, small groups and individuals develop written communication, graphing and measurement skills, independence and confidence. Children need opportunities to concretely explore and understand relationships in this multi-dimensional world. Science can "spark" interest in all areas of study. An example of the Kindergarten science concept "plants require certain things to grow" is outlined to show one way of integrating objectives from other subject areas i.e., the use of centres.

THE LEARNER

VARIETY AND NATURE OF CHILDREN

The emphasis of psychologists such as Piaget, Bruner, Ausubel, and Gagne is placed on experience with concrete materials and the child's need to be involved in actively structuring his or her learning. According to Piaget, children pass through an ordered series of developmental stages, believed to be controlled by the maturation of the brain and the nature of a child's experience. These stages aren't limiting, as all children have different experiences in different areas.

Appropriate activities for Piaget's various stages are:

2 to 6 years - Pre-Operational

Being able to manipulate and carry out physically the actions he/she may not be able to carry out mentally. Exploration and experiences of trying things out to see the result enables them to link cause and effect. An activity is repeated several times, if desirable.

7-12 years - Concrete Operational

Exploring a wide range of problems in real situations and gradually coming to see patterns. Planning and carrying out investigations or methods of problem solving which he/she has devised; discussing results and learning from errors about the variables which should be controlled. Putting problems in concrete terms where doing can support thinking.

13-15 years - Formal Operational

Drawing conclusions from previous learning and applying principles to new problems. Testing ideas by planning experiments which control all the necessary variables. Developing abstract ideas about properties of materials; devising and using theoretical models for predicting and explaining.

Taking this into account, the science program must be experience-based and activity-centered. Concrete experiences are essential for the pre-operational and concrete-operational stages in order to meet changing needs, abilities, interests and learning styles of the children. The science program must give children time, space, and encouragement to explore science and consolidate learning inside and outside the classroom.

MISCONCEPTIONS IN SCIENCE

Misconceptions represent complete systems of explanations which are conceptually wrong. They are usually personal and constructed from one's experiences. K-4 children harbour many misconceptions in science, partly due to their limited experiences and stage of mental development. These misconceptions may be adjusted by teaching science through a wide usage of concrete and relevant experiences, and adequate, appropriate discussions of findings in a non-threatening environment. Some examples of misconceptions are:

1. that an object will float in shallow water but will sink in deep water;

2. that because plants need sun, food and water, the plants will flourish if you give them direct 24 hour sunlight, and as much water and fertilizer as possible;
3. that the metamorphosis of mealworms will result in only more mealworms with the misconception expressed by the question: Who put the beetle in the bottle?

Teachers of science who want to modify their children's conceptual framework need to challenge the children's alternative conception. Some guidelines for teachers are:

- . ask children for their ideas, respect the ideas and explanation offered;
- . guide the students into developing experiments or experiences that will allow them to test their ideas;
- . encourage the children to discuss and resolve the discrepancies between their initial predictions and the new evidence;
- . always listen to see whether students have adjusted their conceptual framework after the experiment or experience.

GIRLS IN SCIENCE

Research shows that girls are biased against areas of physical science through home, media and school experiences at as early an age as six years. Girls have already developed opinions about appropriate

behaviours and occupations for one or the other sex by this age.

"A girl might aspire to be a lawyer but expect to be a typist in a law office; she might aspire to be a doctor but expect to be a nurse."²

Teachers must:

- . consciously model enthusiasm and involvement in science to motivate children to participate and become involved in science;
- . offer bias-free resources (those that give equal consideration to both sexes in career and life-style portrayal);
- . have equal expectations for boys and girls (studies have shown that boys receive considerably more teacher feedback, occupy more physical space, are more critical of girls and of each other, and generally assume the leadership role in a mixed group);
- . encourage both boys and girls in planning, recording, setting up experiments, using equipment and other learning opportunities;
- . encourage projects which recognize skills and interests of both sexes and discourage put-downers or devaluing of "female" interests by male students.

² "Who Turns the Wheel?", Science Council of Canada, January, 1982, p. 82.

THE TEACHING ENVIRONMENT

PROGRAM IMPLEMENTATION

The school administrators have an important leadership role in science program implementation. This role includes the following directions or activities:

- . encouraging a shared management of implementation for the science program by providing opportunities for cooperative planning.
- . monitoring the degree of implementation and the needs of staff.
- . determining the implications of the curriculum for staff training and facilities.
- . providing easy access to the materials and facilities needed for the program. This will include the provision of sufficient funds which would be used to purchase necessary equipment and materials as the need arises.

Some implications of the science program for implementation into the school include:

- . like in the previous curriculum, the new program emphasizes the development of science processes and concepts. The use of activities to develop these processes and concepts will affect teaching methodology and evaluation methods.
- . the K-4 science program has introduced new segments within the program: Flotation: A Property of Matter, life cycles, a consolidation of the previous K-1 program, application of science and

Implementation may require specific work with teachers in order to increase their knowledge and teaching methodology base for these units.

- . the science program suggests some ways to integrate some mathematical and language arts skills into the structure of some topics. Developing additional units whereby mathematics and language skills are an outcome of science units and activities may be required.

Evaluating the effectiveness of the science program consists of judging its worth on the basis of valid information about how well the achieved curriculum meets the objectives of the intended curriculum. Many sources of data should be searched to provide a basis for the evaluation, such as:

- . evaluation of student achievement;
- . analysis of the methods of evaluation;
- . teaching strategies and emphases upon program goals.

Additional sources of information about program evaluation are:

1. Mechling, Kenneth R., "Taking Charge: How Principals can Improve School Science Programs, "Principal, January 1983, pp. 16-21.
2. Mechling, Kenneth R. & Oliver, Donna L., "Activities, Not Textbooks: What Research Says About Science Programs.", Principal, March 1983, pp. 41-43.

3. Mechling, Kenneth R. and Donna L., Promoting Science Among Elementary Principals: Handbook I-IV, National Science Teachers' Association, 1742 Connecticut Avenue, N. W., Washington, D.C., 1983.

COMPUTERS IN SCIENCE

Computers are a recent addition to the learning environment. They offer extensions and support for science learnings. Computers are not a primary means of delivering science education or a replacement for direct investigations. However, they can enrich the science program and provide individual and practice work in a number of ways. These include:

- . developing an awareness of the role of complex technologies in society.

- . simulations;
- . problem solving exercises.

Computers are a way of life in the future for children.

TIME ALLOTMENT FOR THE SCIENCE PROGRAM

Recommended time allotments for K-3 science are 15 minutes daily or 75 minutes weekly and for grades 4-6 are 30 minutes daily or 150 minutes weekly. Time allocations for each unit can vary but teachers should ensure that students are given sufficient time to cover the entire program for any given year.

ENRICHMENT ACTIVITIES

The activities included in the K-4 program provide learning experiences that help students understand and interpret the world in which they live. The activities which appear under the heading of enrichment are intended as extensions to the regular program. These activities have been selected in order to allow students to explore some areas at greater depth.

EVALUATION

STUDENT EVALUATION

The general purposes of student evaluation are to provide:

- . students with an understanding of their development and needs relative to the program;
- . teachers with a basis for planning necessary changes in teaching strategies and the curriculum;
- . information for parents and administrators.

Thus, evaluation should be related to program objectives, and in the K-4 science program, it should relate to science processes and attitudes in addition to content. Further, evaluation must be continuous and use a variety of approaches.

Informal observation techniques whereby teachers observe individual and group interactions in an activity can help to determine needed skill development of students and techniques which can be used to improve their skills.

Formal techniques include achievement and performance tests, checklists of processes, attitudes, and manipulative skills and the examination of products such as reports or projects. Although achievement tests (pencil and paper variety) are generally considered to evaluate content most effectively, other objectives of the program such as science processes and attitudes can be evaluated by written and performance items, checklists and other means.

SAMPLE EVALUATION TECHNIQUES

A. Processes Checklist

Monitoring student achievement in science processes may be helped by observing student behaviours in applying the processes. The student should be able to carry out the processes noted in the objectives in each science unit in the curriculum, at the appropriate grade level. A checklist from these objectives can be made, the concepts are taught, and then the process involved can be checked off for those students who show mastery. Samples of some student behaviours are:

<u>Process</u>	<u>Behaviour</u>
Observing	. Identifies properties of an object with and without sight; uses a variety of senses. . Selects objects according to special properties. . Identifies changes in an object and parts of a system. . Places a greater emphasis upon quantitative observation (estimating, measuring). . Describes motion of an object relative to a reference point.

- Communicating
- . Reads and constructs bar graphs, simple tables, and charts.
 - . Interprets accurately information and instructions presented orally, in writing, and in graphic or pictorial form.
 - . Reports information concerning an investigation; e.g., states the problem, records the results, and reaches a conclusion.

B. Scientific Attitude Checklist

<u>Attitude</u>	<u>Behaviour</u>
Questioning of All Things	. Shows curiosity with objectivity and open mindedness.
Searching for Data and Their Interpretation	. Looks for support for their ideas.
Demanding Verification	. Seeks data and information to validate observations or explanations. . Questions conclusion based on incomplete data.
Respecting Logic	. Modifies views in the face of new evidence . Shows respect for the ideas of others.

C. Performance Items

These items may be used individually or in a group (station) setting to test process and manipulative skills at the grade 3 level. For example:

Birds

Purpose: to test observing/classifying, interpreting skills.

Procedure: Pictures of two birds are provided and children are asked to see what is different about them and how they are different. Use only observable differences, i.e. colour/pattern, size/shape, environment.

Marbles in Tubes

Purpose: to test observing, inferring, interpreting data, explaining physical phenomena, safety/manipulative skills.

Procedure: Three covered tubes in upright positions, each containing liquids of different densities (i.e., water, vegetable oil, methyl alcohol) and a marble. Tell students that the marbles are all the same size and weight. Have students examine the tubes and turn them upside down. Ask students to write down three things they observe and to propose a reason for the marbles taking different times to fall.

SAFETY AND SCIENCE^{3,4}

The K-4 curriculum contains few safety hazards to children. Teachers should establish proper classroom behaviour, conducive to safe operation. Common sense is the best guide to follow in the area of safety. Manageable group size and a well-planned lesson will allow students to work without confusion. By showing concern for safety, the teacher can help the students develop a positive attitude in regard to safety.

General Safety Guidelines

- . At the beginning of the science class, remind the students about the applicable safety precautions they must take during the lesson.
- . Give clear, complete directions before allowing the students to begin any activity.
- . Instruct students not to taste or touch substances or materials without permission.
- . Stress the importance of not touching one's eyes, ears and mouth while working with plants, animals and chemicals.
- . Allow time for clean-up and proper storage of materials.
- . Closely supervise your students at all times.
- . Familiarize students with first aid, fire drill and other emergency procedures.

³ "Safety in Science." Department of Education, 1982.

⁴ "Safety in the Elementary Science Classroom," National Science Teachers' Association, 1742 Connecticut Avenue, N.W., Washington, D.C., 20009.

Some tips on animals and plants are:

Animals

- . Check for student allergies.
- . Obtain animals only from a reputable dealer.
- . Keep in suitably sized enclosures.
- . If animal is in poor health, remove it from the room until a veterinarian has been consulted.
- . Always wash hands after handling the animal.
- . Keep an animal only for as long as it is a meaningful part of a classroom program.

Plants

- . Check for student allergies.
- . Be aware that parts of some plants are poisonous, i.e. leaves - rhubarb, dieffenbachia;
sap - poinsetta.
seeds - castor beans

ATTITUDES AND SKILLS

ATTITUDES AND VALUES

One of the greatest achievements of science is to have developed scientific methods that work almost independently of the people who are conducting the scientific investigations. Thus, children learning science must also learn many attitudes toward science such as:

- . objectivity;
- . open-mindedness;
- . fairness;
- . accuracy;
- . thoroughness;
- . perseverance;
- . curiosity;
- . creativity;
- . risk taking.

The rudiments of these scientific attitudes can be learned very early in school, based on a gradual understanding, rather than direct teaching.

SCIENCE, TECHNOLOGY AND SOCIETY

School science is sometimes understood by students to be an end in itself. A science, technology and society (STS) emphasis attempts to help students understand the applications of science and how this relates to the world around them, making science much more relevant.

For the K-4 level, the major STS emphasis is the child's home, community environment; expanding to include cities, provinces and beyond.

The methods for incorporating STS are varied. One approach is to develop a science concept first, followed by applications, i.e. introduce the concept of heat insulators and later apply the concept by testing house insulation or designing ice-cube insulators. Another approach is to introduce the application first, and conclude with the basic science concept, i.e., Discuss how we keep our house warm in winter, or why do people replace old windows. This is the application of the science first and through testing materials, the students will conclude with the basic concepts of insulators.

Overall, it is suggested that STS goals should receive some 15-20% of the total emphasis. Some units and/or parts of units in the curriculum lend themselves more to STS activities and discussion than others. This guide marks some STS objectives/activities with two asterisks (**) beside it. Teachers should feel free to find or develop their own examples.

ENVIRONMENTAL EDUCATION

Concerns for the environment have become so important that teachers need to be aware of imparting these values to children by example as well as by formal teaching. Such environmental values include:

- . responsibility for living organisms;
- . consideration for others;
- . interaction with the environment in a responsible manner;
- . concern and care for the environment.

Values taught through science education transfer well to life outside the classroom, developing environmentally alert individuals capable of making well-reasoned interpretations and motivated to taking responsibility for their decisions throughout life.

SUSTAINABLE DEVELOPMENT STRATEGIES

Sustainable development is the process of maintaining our natural heritage. It is important that students are made aware of the need for judicious use and management of our natural resources. The students are the stakeholders. They need to be informed about environmental concerns and the economic devastation which occurs due to a lack of environmental protection.

A Sustainable development strategies (SDS) emphasis in the science program will allow students to identify the areas in which environmental damage is taking place and to explore methods by which the environment can be protected. This SDS emphasis begins in kindergarten and continues throughout the entire science curriculum.

Some units lend themselves more to SDS activities and discussions than others. Teachers are encouraged to develop and foster SDS awareness whenever the opportunity arises.

This guide identifies the SDS related objectives with three asterisks(***) beside them.

PROCESS DEVELOPMENT

Processes are intellectual skills, developed and used both in science and other areas of study. When children experiment with materials and examine ideas both processes and concepts are being developed and used. Observation and classification skills are important to the development of more complex processes such as interpreting data and are therefore classified as basic processes. These basic processes should begin to develop from early experiences. Experimenting and controlling variables are termed integrated processes and can usually be more effectively learned by children in the late concrete and formal operational states. Each process, in turn, consists of a series of levels of difficulty, i.e., the process of observation varies from the skill of describing an object in terms of a single property to identifying the object in terms of its many properties. The basic processes are gradually developed from early childhood through grade four. The integrated processes are stressed at higher levels, but all processes can be informally introduced to young children through simple investigative situations presented and directed by the teacher.

It should be noted that many of the main processes often include other activities that reflect various aspects of the process:

- . observing includes identifying;
- . classifying includes comparing and ordering;
- . communicating includes describing and graphing.

Observation

Observing is one of the basic process skills of science. It involves obtaining information about objects, situations or events using the five senses. Observation may be qualitative or quantitative in nature. Observing provides both a basis for new inferences or hypotheses and a tool for testing existing inferences and hypotheses.

Measurement

Measuring is the process of determining the dimensions or quantity of an object or event. It usually involves comparison of size, volume, mass, temperature and time using non-standard/standard units.

Classifying

This process is the grouping of objects, concepts, or events on the basis of some observable properties in order to show similarities and/or interrelationships.

Inferring

Inferring means suggesting more about a set of conditions than is observed. Inferences are based upon observed data and past experience. Inferences may evolve from both direct and indirect evidence and are modified on the basis of new evidence. An example of inference: "to infer the identity of objects on the basis of observation of shadows".

Communicating Data

This is a process that occurs between the observation stage and the interpretation stage. It usually involves the organization of "rough" data into a more compact and meaningful way (ordering, comparing), depicting the data pictorially or graphically, and processing data mathematically (averaging, finding slopes) in order to facilitate interpretations.

Predicting

Predicting is a forecast about future events based on previously obtained data. Predictions can be made on the basis of ordered data or extrapolation beyond an observed pattern of events. An example of prediction: "to predict the consequences of changes in an animal habitat".

Hypothesizing

Hypothesizing is an educated guess about an expected relationship between two variables in an attempt to explain a cause and effect relationship. The hypothesis should be testable.

Recognizing and Identifying a Problem

This process involves recognizing and focusing on a problem that can be investigated, making assumptions about possible variables, and the ability to narrow down the question under investigation in order to work towards a solution.

Identifying and Controlling Variables

This process involves deciding which variables will influence the outcome of an experiment or event and deliberately controlling all recognized variables in a systematic manner. This combination of relationships (system) consists of a manipulated (independent) variable which is changed in a systematic way, corresponding changes in an observed responding (dependent) variable and all other variables are held constant (controlled). An example is a pendulum system where the time of swing (responding) is affected by the pendulum length (manipulated) and other variables such as mass of the bob and arc of the swing are kept constant.

Designing an Experiment

Experimenting is a cause and effect test between two variables. All processes may be involved. This may begin with setting a problem to be solved identifying a variable to be controlled, making operational definitions, devising the test to be carried out and finally to follow the prescribed procedure.

Interpreting Data

Interpreting is the process by which sense is made out of the observations in the form of inferences, generalizations or explanations. Thus, selecting data which supports inferences, identifying a general trend, and stating a conclusion or relationship are integral parts of this process. An example is: "state the average growth rate of bean plants."

Operationally Define

This is a process whereby objects or events are defined in a way which can be tested or observed such as: "When I join copper wires, a bulb and a dry cell in this way, a bulb will light up."

Using Space/Time Relationship

All objects occupy points in space at a given point in time. This process concerns spatial relationships and the ability to describe such things as shape, symmetry, direction, position and spatial arrangement, and speed.

PROBLEM SOLVING

Problem solving is a familiar teaching/learning approach which lends itself to science teaching. Problem solving includes:

- . recognizing problems;
- . discussing or thinking about solving them;
- . trying out one solution;
- . assessing the effectiveness of the solution;
- . possibly modifying the solution in the light of experience.

The approach can be used to help children understand the world of human endeavours through practical problem-solving activities, involving using and discovering science skills in conjunction with "design and make" activities.

Problem solving exercises can vary considerably in content and in the processes and strategies employed:

- . exercises which are of a technological nature where children are asked to design, construct, test and evaluate a system;
- . exercises designed to carry out a scientific investigation;
- . decision making exercises where children discuss a problem and come up with their own solution (role playing, games, simulations).

Preferences should be given to activities that involve a problem-solving approach and which:

- . encourage creativity and inventiveness in designing and making 3-dimensional models which achieve a given task;
- . cause students to learn or reinforce concepts relating to energy, materials and their properties, structures, forces, speed, measurement, accuracy, stability and control;
- . give opportunities to develop manipulative skills with simple tools and range of materials;
- . develop communication skills within and between teams and adults including drawing and display of ideas and achievements;
- . involve some element of planning and organization.

Problem solving should be a regular part of the science program. This guide marks problem-solving objectives/activities with one asterisk (*) beside it.

SCOPE AND SEQUENCE

Process Development: When a process is introduced at an early stage, it should be developed and maintained in subsequent years.

PROCESS/GRADE	K	1	2	3	4
Observing	I	D	D	E	E
Measuring	I	I	D	D	E
Classifying	I	I	D	E	E
Inferring	I	I	D	E	E
Communicating	I	I	D	D	E
Predicting	I	I	D	D	E
Recognizing a Problem	I	I	D	D	E
Controlling Variables			I	I	D
Hypothesizing				I	D
Interpreting Data			I	I	D
Operationally Define			I	D	D
Design Experiments			I	I	I

Note:

- I - Introduce processes using primarily teacher input.
- D - Develop processes with less teacher input.
- E - Extend processes to become more student controlled and directed.

ATTITUDE DEVELOPMENT

When an attitude is introduced at an early stage, it should be developed and maintained in subsequent years.

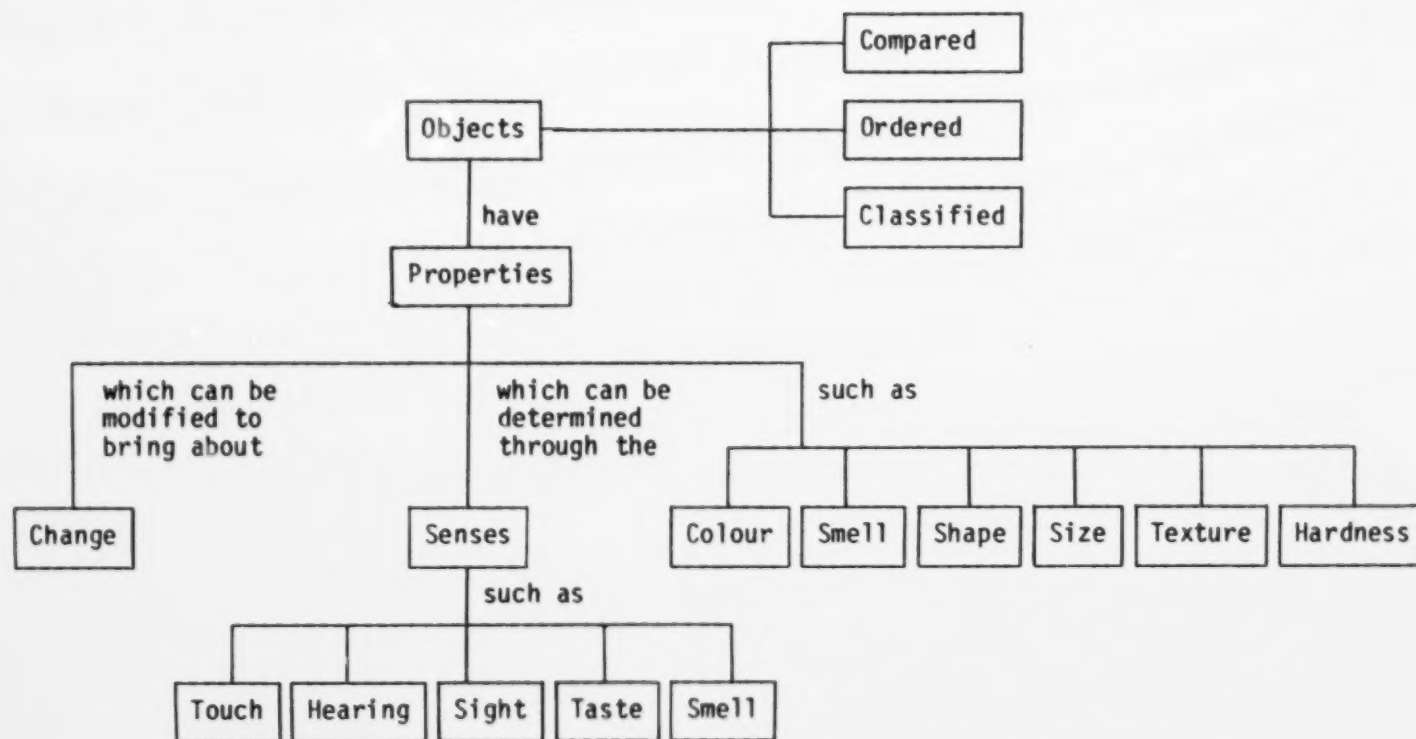
ATTITUDE/GRADE	INTRODUCTORY GRADE
Appreciate all living things.	K
Be committed to good animal care.	1
Be aware that animals can cause allergic reactions.	1
Value differences and similarities among humans.	1
Appreciate the adaptive value of some animal behaviours.	3
Recognize the need for safety in all activities.	K
Recognize the need for standard units and references.	1
Appreciate the need for verification.	1
Develop curiosity about natural events.	2
Recognize the need for accuracy in measuring.	2
Recognize that predictions can be made as a basis of valid evidence.	2
Seek plausible hypotheses to interpret findings.	4
Recognize the need for an empirical test as a basis for judging hypotheses.	4
Respect the importance, order, and beauty of the environment.	2
Recognize the need for man's care of the environment.	2
Recognize the importance of uses of different energy sources.	3
Develop an interest in learning about the universe.	3
Recognize the need to control sound in the environment.	4
Appreciate the technology of communication.	4
Appreciate the technology of electricity.	4
Appreciate the power of geological forces.	4
Recognize the dependence of man upon geological forces.	4
Recognize the importance of water as a resource.	4
Recognize the need to control and handle water wisely.	4

General Program Overview

THEME	K	1	2	3	4
Inter-Dependency and Interaction	Living and Non-Living Organisms	Animals are Living Organisms ----- People are Living Organisms	Living Organisms in the Environment	Life Cycles	Population Interaction
Matter and Energy	Properties of Objects	Properties of Matter	Flotation: A Property of Matter	Energy, Heat and Temperature ----- Changes in Matter	Electricity ----- Structures ----- Sound
Earth, Time and Space	Size, Position and Time	Comparing and Measuring Events	Light and Shadows ----- Measuring Time, Objects and Position	Sun, Earth and Moon ----- Air and Air Pressure	Water and Land

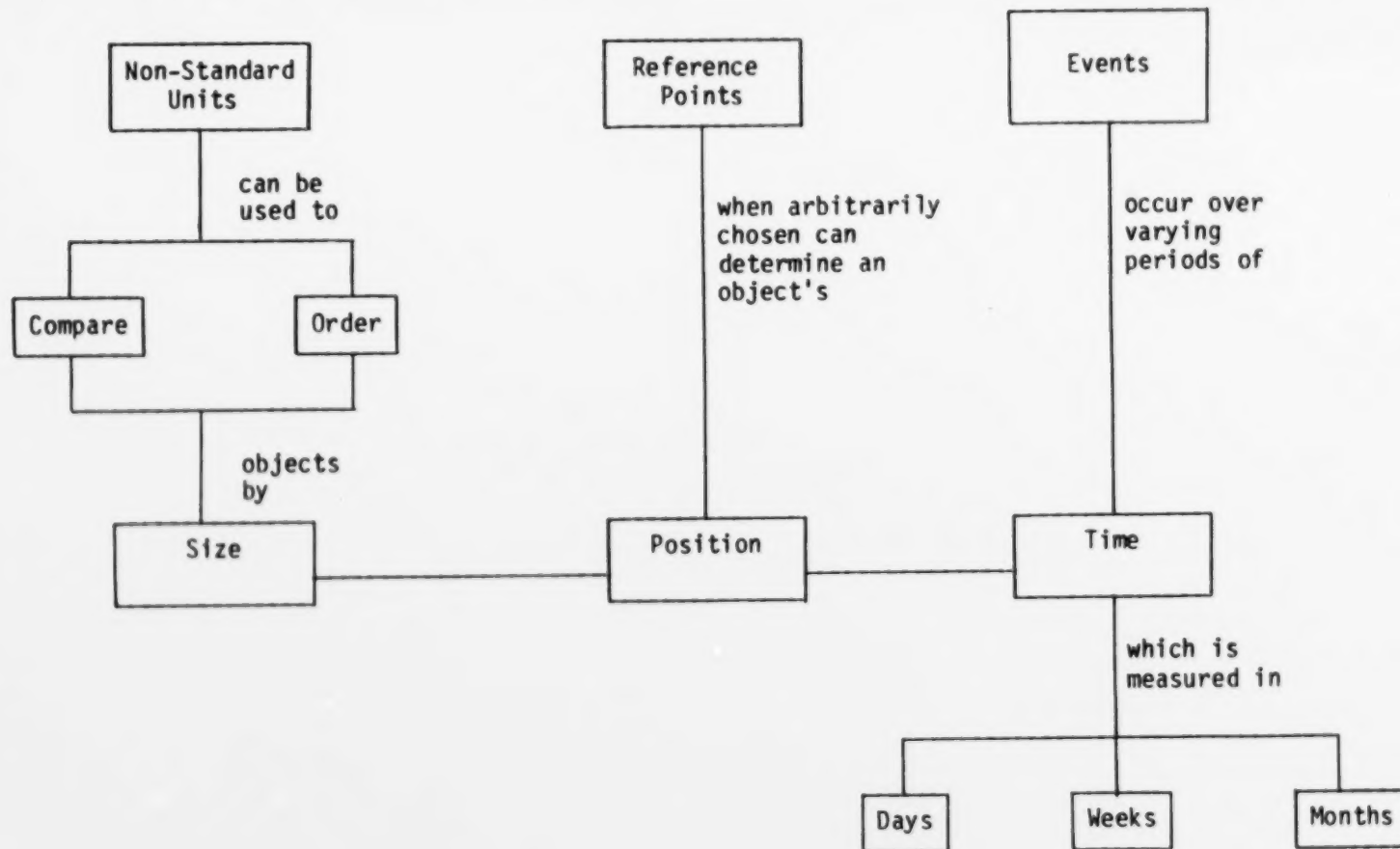
KINDERGARTEN

CHANGES IN MATTER AND ENERGY: PROPERTIES OF OBJECTS



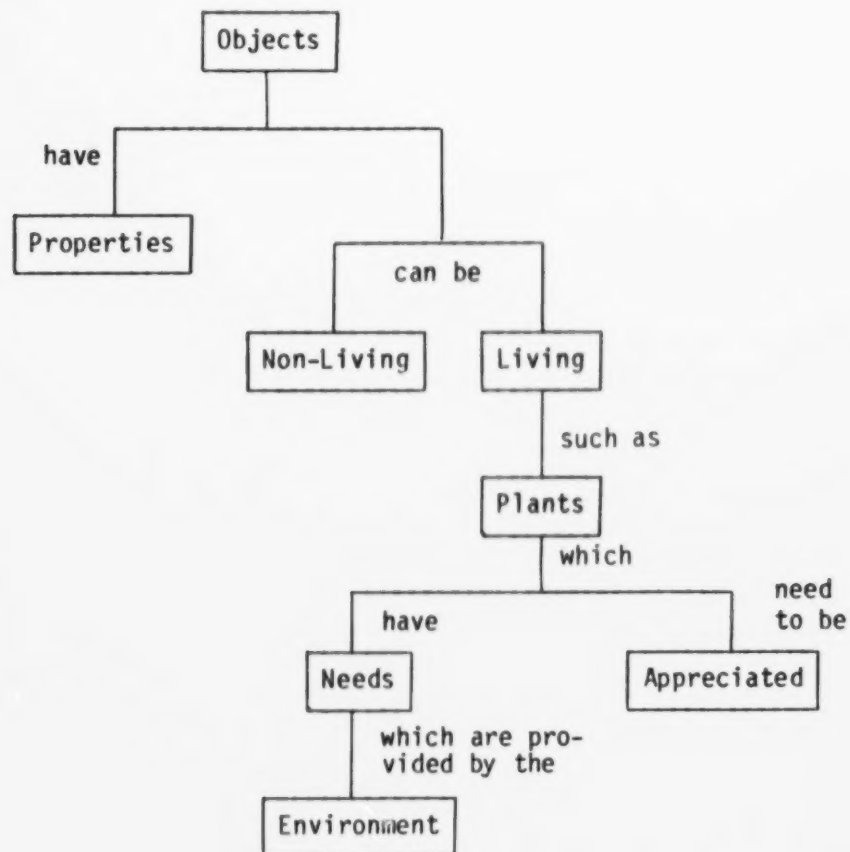
KINDERGARTEN

EARTH, SPACE AND TIME: SIZE, POSITION AND TIME



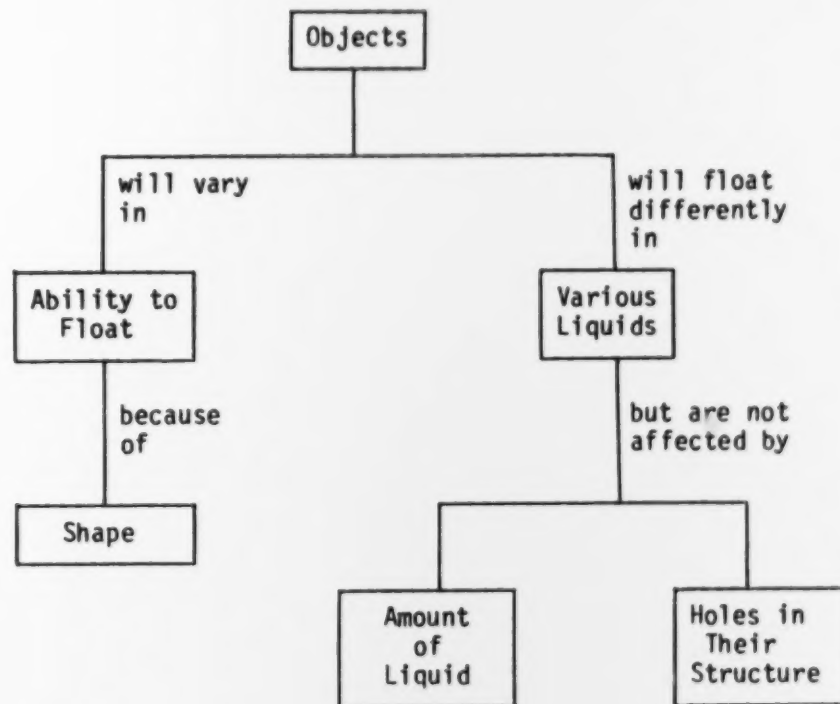
KINDERGARTEN

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: LIVING AND NON-LIVING



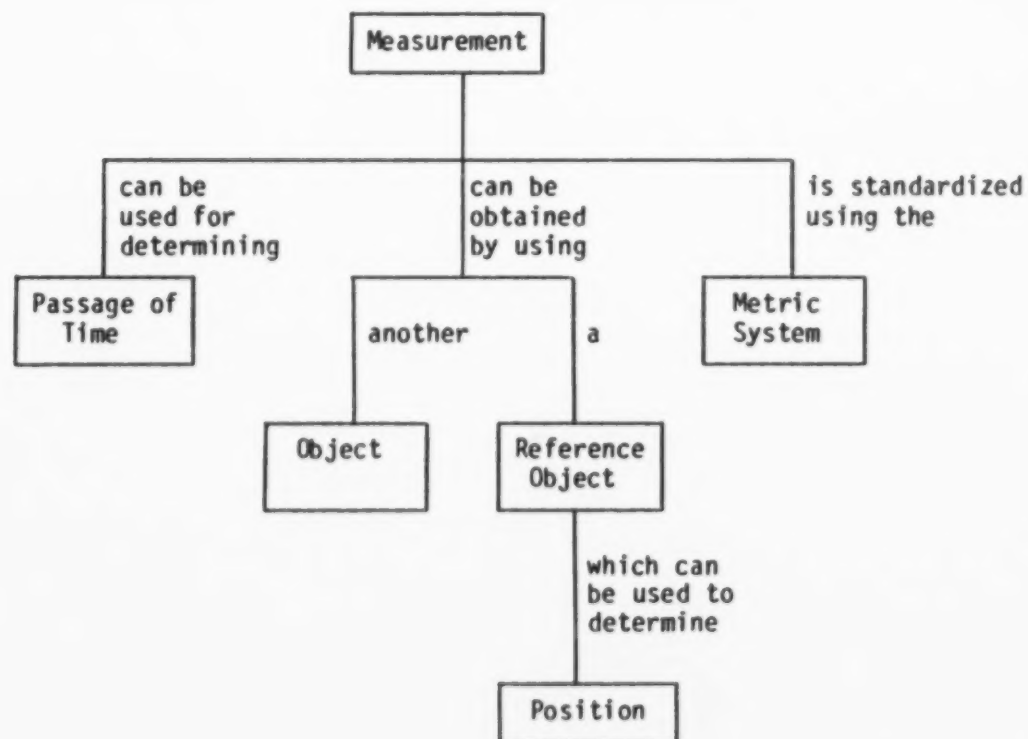
GRADE TWO

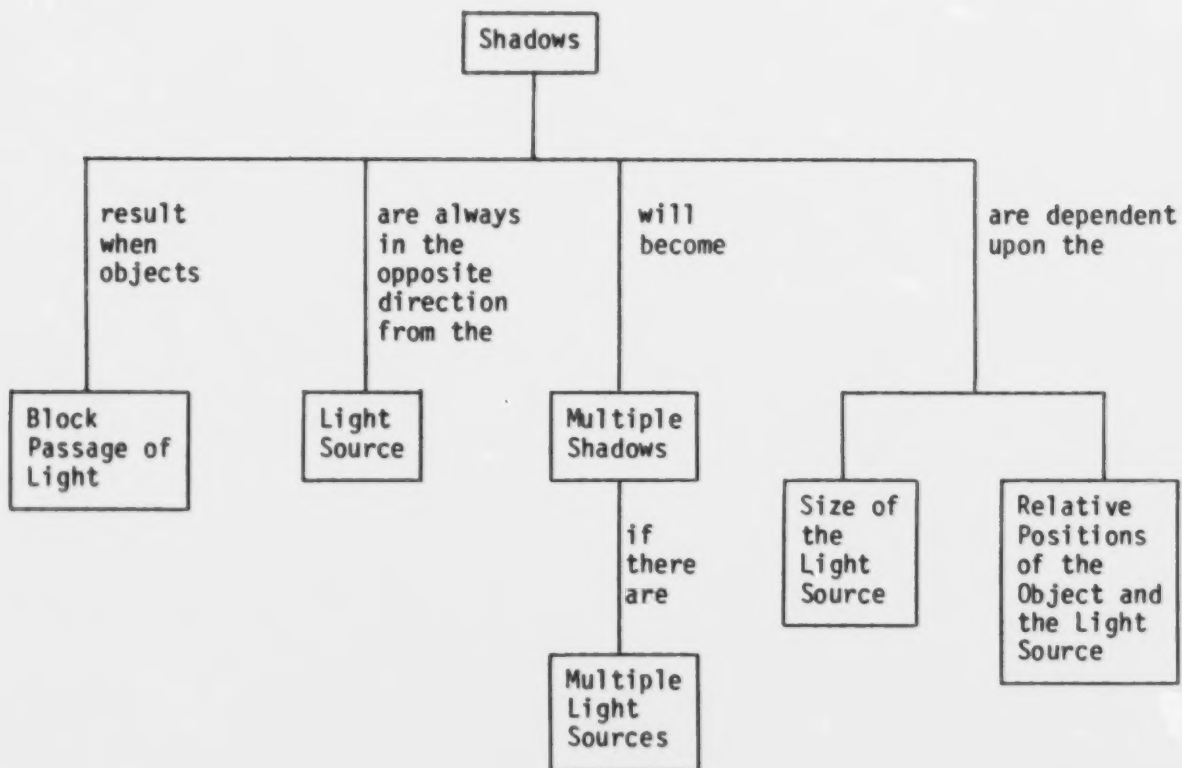
CHANGES IN MATTER AND ENERGY: FLOTATION: A PROPERTY OF MATTER



GRADE TWO

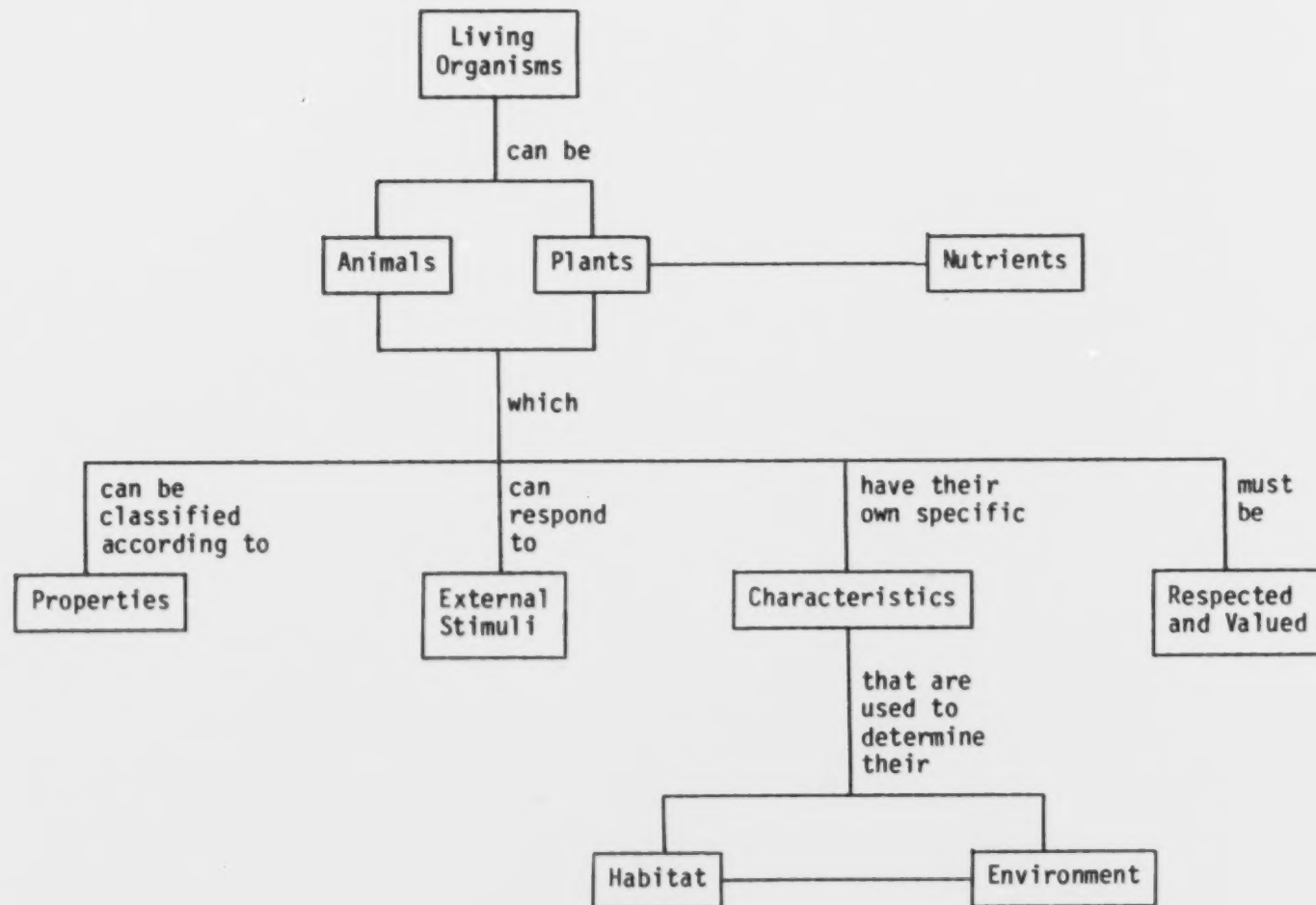
EARTH, SPACE AND TIME: MEASURING TIME, OBJECTS AND POSITION





GRADE TWO

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: LIVING ORGANISMS IN THE ENVIRONMENT



MATERIALS LIST

This is a suggested minimum list for the K-4 Science program. Many other items should be readily available at school or in the home. Teachers should be advised to review the units so that locally available material may be obtained in advance. A petty cash fund needs to be available in order that purchases may be made on an ongoing basis.

Basic Materials

- pop bottles (glass)
(plastic - 500 ml, 1 litre, 2 litre)
- plastic containers and lids in all sizes
- egg cartons
- trays of assorted sizes
- cloth of all textures, colors, and materials
- nylons and panty hose
- newspaper
- jars of all sizes with lids
- tin cans of all sizes
- pine cones, bark, twigs
- popcorn kernels
- food colouring
- a variety of woods
- a variety of sandpaper
- coins
- milk cartons
- alka seltzer tablets
- sponges
- assortment of food and cooking items
- crackers, orange juice crystals, detergent, spaghetti, macaroni, salt, sugar, sugar cubes, baking powder, vinegar, flour, syrup, corn-starch, vegetable oil, molasses, dish detergent.

- popsicle sticks
- large and small graph paper
- wax (paraffin wax)
- vegetable oil, molasses, dish detergent
- an assortment of string
- an assortment of wool
- waxed paper
- aluminum foil
- plastic wrap
- paper towels
- kettle
- pie plates styrofoam and tin
- insulated wire (copper)
- toilet rolls
- gravel
- sand
- ping pong balls
- cardboard of all sizes and thickness
- plastic combs
- tooth picks
- cereals
- cotton balls
- threads
- an assortment of nails
- fossils (plastic models can be purchased)
- pulleys single and double
- index cards
- pictures
- balloons
- latex gloves
- straws
- spoons
- elastic bands
- thumbtacks
- paper clips

- straight pins
- candles
- dry cells
- light bulbs (miniature)
- scale (kg)
- magnets
- magnifying glasses
- fixed pan balance
- aquarium
- variety of seeds
- plasticine
- meter stick
- tape
- tape measure
- weights (g)
- graduated cylinder
- beakers
- medicine droppers
- test-tubes
- thermometers
- rubber stoppers
- corks
- glass tubing
- filter paper
- marbles
- baggies
- paper towels
- mirrors
- steel wool
- washers
- styrofoam cups
- paper cups
- clock (with second hand)
- markers
- drinking straws

SPECIFIC MATERIALS

Kindergarten

1. attribute blocks
2. terrarium
3. bulbs (for planting)
4. soil

Grade One

1. attribute blocks
2. logic sets (trees, vehicles, etc.)
3. egg beater
4. metronome (if available)
5. graph paper
6. bathroom scale

Grade Two

1. graph paper
2. 30 cm. ruler
3. flashlights (different sizes)
4. light bulb and socket
5. chart paper

Grade Three

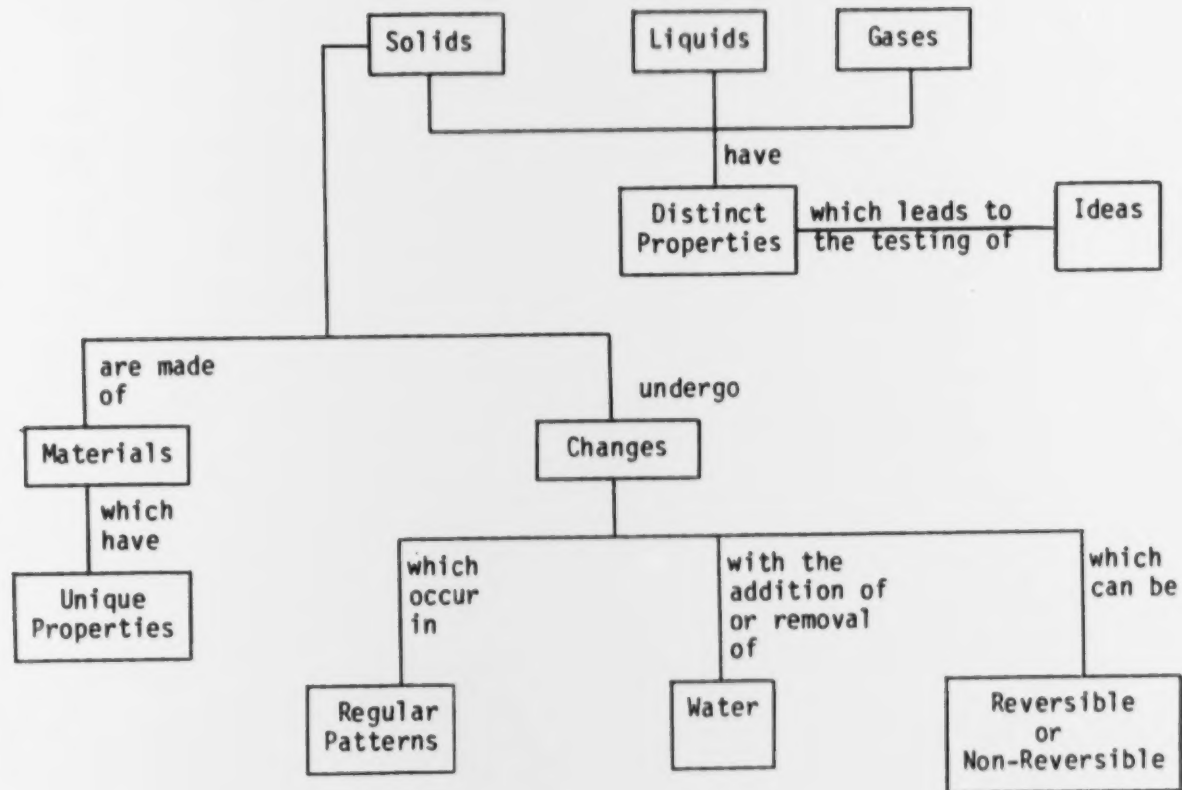
1. light bulb and socket
2. ball and ring apparatus
3. rubber tubing
4. meal worms
5. beetles
6. earthworms
7. glass flask
8. wax (paraffin)

Grade Four

1. nichrome wire
2. sockets (for miniature light bulbs)
3. alligator clips
4. fine steel wool
5. tuning fork
6. slinky
7. ticking clock
8. microscope slides
9. cover slips
10. microscope
11. prepared animal cells
12. iodine
13. skeleton set

GRADE ONE

CHANGES IN MATTER AND ENERGY: PROPERTIES OF MATTER



GRADE ONE

TITLE: CHANGES IN MATTER AND ENERGY: PROPERTIES OF MATTER

RATIONALE: Through the use of process skills, and their five senses, children will be able to identify two materials by their distinguishing properties. Changes can occur in the properties of solids. Some changes can be ordered. Some changes can be more easily reversed than others.

MAIN CONCEPT(S):

1. Objects (matter) commonly exist in 3 distinct forms (solids, liquids, gases).
2. Each form has characteristic properties.
3. Changes in these forms occur and are sometimes in observable patterns of order and time.

- * Refers to problem solving
- ** Refers to STS
- *** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Solids have distinct properties:	a) <u>Observe, describe and record</u> the distinct properties of solids.	Review the <u>properties of objects</u> from kindergarten. Use two different size balls, two different size boxes, two glass pop bottles of different sizes, etc.
	b) <u>Identify</u> solids in a group of solids and liquids.	Use chart paper and brainstorm the properties of these objects and other solids. Note that solids will retain their shape and they can be stacked.
2. Solids can be classified by physical properties.	a) <u>Classify</u> objects on the basis of one property.	Have a classroom scavenger hunt to find objects based on one property. Classify and record objects on a chart using size, colour and shape.
	b) <u>Classify</u> objects on the basis of two properties.	Play "I Spy" to find objects based on two properties such as size and shape or colour and shape.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) <u>Identify</u> multiple properties in single objects.**	Have students identify the properties of various objects (attribute blocks, Logic People). Try household objects such as old keys, lids, different pasta, corks, screws, nails, etc.
3. Solids are made of materials which have unique properties.	a) <u>Infer</u> the identity of objects which are made of different materials.	Have one student give clues about an object and have the others identify it, i.e., it bends or it is shiny. Play "I Spy." Use feely bags. Compare objects by looking at similarities and differences.
	b) <u>Identify</u> objects made of one material.	
	c) <u>Identify</u> objects made of more than one material.	Change a display of materials each day to include objects with growing numbers of material. Day 1: one material; Day 2: two materials.
	d) <u>Classify</u> objects in terms of the kind of material of which they are composed.***	Classify objects onto sheets labelled; metal, wood, fabric, paper, glass, plastic. Classify and list materials which are recycled. **Observe clothing. Discuss why it is made of different materials.
	e) <u>Compare</u> samples of the same type of material in terms of a single property.	Samples of three or four materials can be tested, i.e., hardness or woods using a nail to scratch, weight of metals, length of string, texture of fabric (velvet, burlap, fur, leather and silk), thickness of wool.

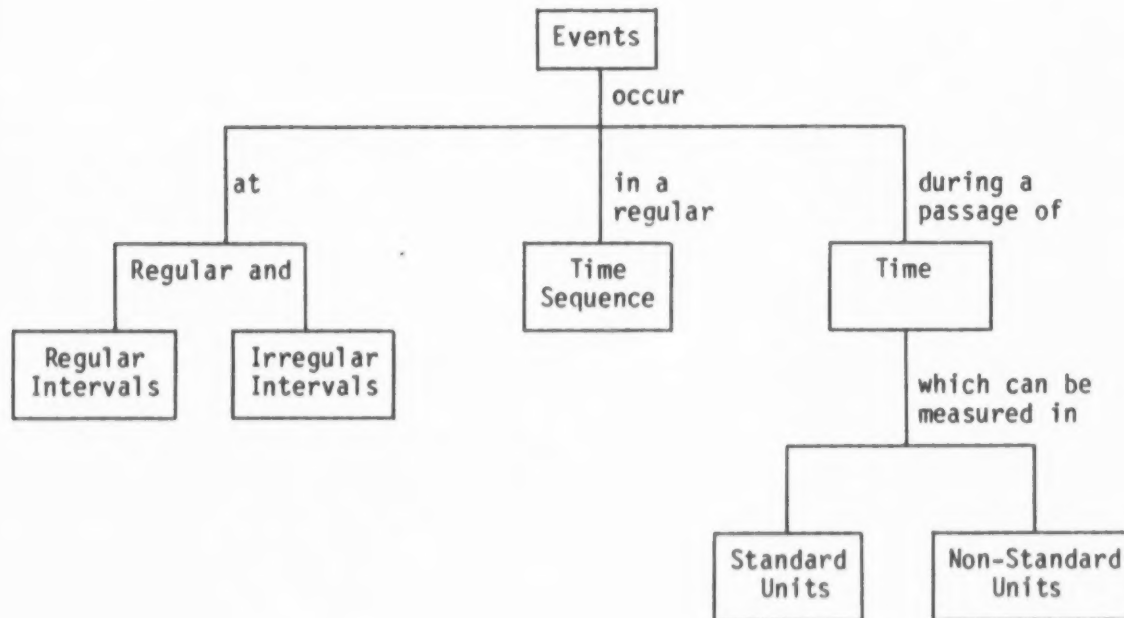
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
4. Liquids have distinct properties: i) take shape of the container they are in; ii) splash; iii) can be poured; iv) form drops.	a) <u>Observe, describe and record</u> the distinct properties of liquids. b) <u>Compare</u> liquids to solids.	Demonstrate: Pour coloured water into bottles of different shapes. Tilt a jar of water to observe the shape of the liquid. Place single drops (by eye-dropper) on waxed paper or a number of drops into a shallow dish. Discuss observations.
5. Gases have distinct properties: they completely fill any space into which they are placed.	a) <u>Observe and recognize</u> the existence of gases. b) <u>Infer</u> the presence of a gas.	Fill a balloon with water, then blow one up. Both are full but one has a liquid, one has a gas. Using a straw, blow bubbles into a liquid. Try to put an inflated balloon into a jar. (The balloon should be slightly larger than the jar mouth). The balloon cannot be pushed into the jar. Place a straw against the inside mouth of the jar. Now push the balloon into the jar. Have a child place his/her hand above the straw as the balloon is being pushed in. You should feel the air being displaced. Blow onto a cold mirror or window. Move a paper by blowing through a straw. *Design and construct a pinwheel. Have them blow on their hands to feel the air. Catch air in a plastic bag.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
6. The properties of some solids will change when water is added.	a) <u>Observe, identify and describe</u> changes in the properties of solids when water is added.	Select objects that change readily on contact with water (sugar, soil, crackers, drink powders) and objects which do not change readily (spaghetti, celery, wood). Make gelatin dessert and have students observe various stages of solidifying (use only one cup of water per package). Have students identify changes in properties, i.e., package of drink crystals and a glass of mixed drink, wet paper towel and dry paper towel. ENRICHMENT ~~Make gelatin~~ using hot and cold water. Predict which will change first.
	b) <u>Predict</u> changes which will occur when water is added to some solids.*	Provide rice, nickels, paper, soap powder, tempera paints and cookies. Have students predict possible changes and <u>test</u> their predictions.
7. Changes in properties of solids can occur when the objects are heated or cooled.	a) <u>Observe</u> changes when objects are heated or cooled.**	Add heat to butter, cool the liquid butter. Use chartpaper and list objects which change when heated or cooled. Test some of them so that students can observe the changes.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	b) <u>Infer</u> the reason for change by comparing changed objects to the originals.	Have students match pictures of changed and unchanged materials (bread and toast, cake and dough, wood and ashes) and describe the properties changed.
	c) <u>Be aware</u> of safety needs when using heat.**	Make safety posters related to heating in the home and the school.
8. Some changes occur in a regular pattern and can be ordered.	a) <u>Compare</u> and <u>order</u> pictures which illustrate change.*	Groups of three or four pictures out of sequence, can be ordered, i.e., food being prepared, snow- man melting, pictures of growth.
9. Some changes can be reversed, others cannot.	a) <u>Discriminate</u> between changes in terms of ease of reversal.	Have students identify changes which can be reversed--moving a chair, inflating and deflating a balloon; which cannot be reversed--breaking chalk, sharpening a pencil, burning a candle, tearing up paper.
	b) <u>Record</u> changes which can and cannot be reversed.	Chocolate Chip Cookie Mining. Have students mine the chips out of cookies, then try to put the cookies back together. Have the students suggest a list of changes which can and cannot be reversed.
10. Appreciate the need for testing of ideas.	a) <u>Be aware</u> of the need to test ideas.	Discuss why we need to test new ideas and relate this to why scientists must test ideas.

GRADE ONE

EARTH, SPACE AND TIME: COMPARING AND MEASURING EVENTS



GRADE ONE

TITLE: EARTH, SPACE AND TIME: COMPARING AND MEASURING EVENTS

RATIONALE: Through the use of process skills children will develop the ability to use standard units to measure the passage of time (i.e. clocks, calendars).

MAIN CONCEPT(S): Events occur in a particular order or sequence and last varying lengths of time. Events may be regular or irregular in frequency.

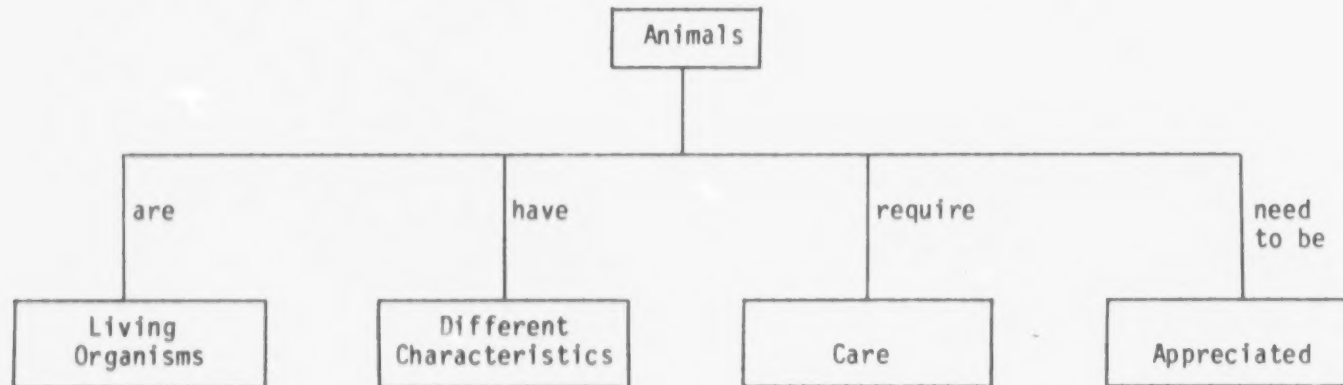
- * Refers to problem solving
- ** Refers to STS
- *** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Certain events occur at regular intervals; others occur at are irregular intervals.	a) <u>Distinguish</u> between regular and irregular events. b) <u>Observe</u> events that are regular or irregular.	Have students match pictures to each heading (regular event/irregular events). Set-up a swinging pendulum. Show them a watch with a second hand. These are regular events. The swinging of a pendulum and the movement of a second-hand are regular events. Watch some corn popping or listen to actual traffic sounds or obtain a tape recording of traffic sounds. These are examples of irregular events.
2. Events occur in a regular time sequence (days, weeks, months).	a) <u>Sequence</u> various events in chronological order.*	Use cut up comics for the students to put back into sequence. Watch the sequence of traffic lights. Show pictures of each of the four seasons and place them in chronological order.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
3. Passage of time can be measured using non-standard units.	a) <u>Time</u> common activities using non-standard units.	Construct simple timers such as a drip clock, sand or candle clock. While putting on a coat or lining up, count ball bounces or hand claps. A dripping tap can also be used.
4. Passage of time can be measured using standard unit.	a) <u>Describe</u> the need for a standard time unit.	Discuss why such things as dripping taps are not good timer devices. List examples of problems that might occur without a standard time unit--TV shows, doctor's appointments, arriving at school.
	b) <u>List</u> types of devices created by technology to measure standard time units.**	Brainstorm various devices. The list can include clock, watch, digital watch, grandfather clock, stop watch, appliance timer and light timer.
	c) <u>Recognize</u> that timing devices have changed over time through the use of technology.	Discuss sun dials, shadow clocks, sand clocks, candle clocks, hourglass, mechanical clocks, digital clocks.
	d) <u>Observe</u> the relationship between the passage of one hour and events that occur in the period.	Chart noon hour activities that occur within a one hour period. They should happen during the period of one hour.

GRADE ONE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: ANIMALS ARE LIVING ORGANISMS



GRADE ONE

TITLE: INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: ANIMALS ARE LIVING ORGANISMS

RATIONALE: Through the use of process skills, children will be able to recognize that animals are living organisms. Children will recognize that humans and animals have a unique relationship in today's world.

MAIN CONCEPT(S): Animals are living organisms. Humans must help care for and provide protection for all animals, not only for pets.

- * Refers to problem solving
- ** Refers to STS
- *** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
<u>ANIMALS</u>	The student should be able to:	
1. Animals are living organisms.	a) <u>Describe</u> animals they know.	Have a discussion and chart students answers.
	b) <u>Recognize</u> and <u>identify</u> animals from pictures.	Use pictures for comparison and discussion. Introduce six common animal groupings (insects, mammals, birds, reptiles, fish, amphibians).
	c) <u>Discuss</u> characteristics of animals.	Have a discussion and chart all characteristics that are brought out. Include how animals: i) breathe ii) move iii) eat iv) have young, v) grow.
	d) <u>Recognize</u> and <u>identify</u> animal parents and offspring.	Use pictures for a matching activity.

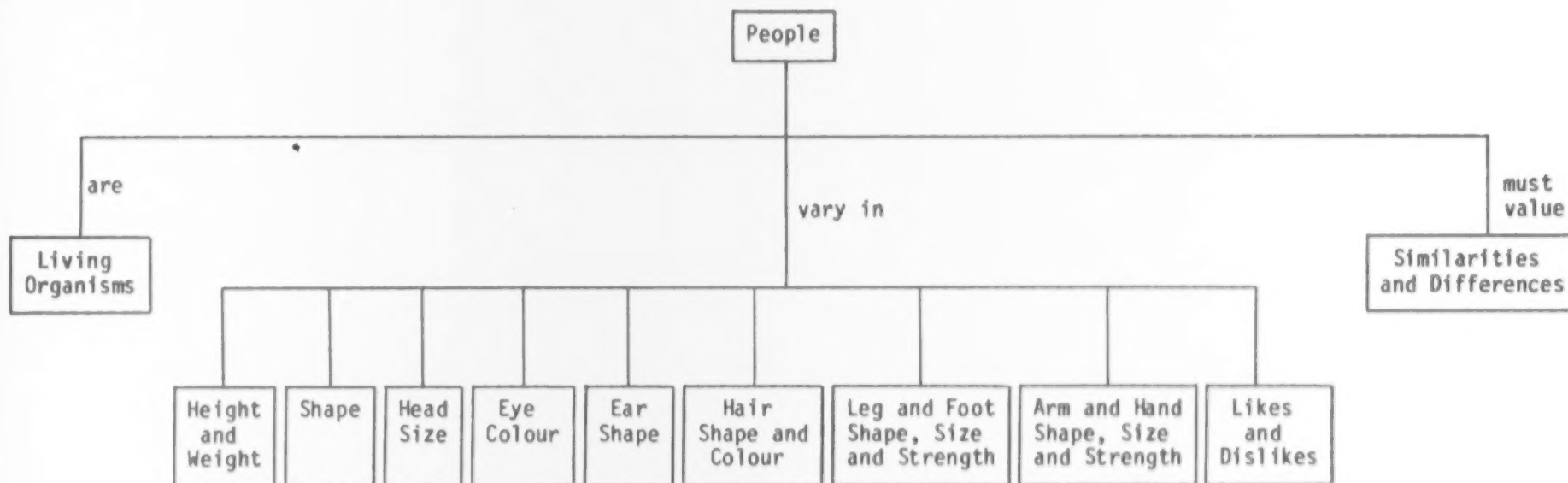
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
2. Different animals have different characteristics.	a) <u>Observe</u> animals and <u>describe</u> their similarities, <u>differences</u> .	Observe the types of food, size, colour, skin covering, movement, etc.
	b) <u>Observe</u> and <u>describe</u> similarities and differences between parents and offspring.	Use pictures, audio-visuals, hands-on materials for observation. Compare animals on a farm to those in a zoo or in a forest and/or compare to people.
	c) <u>Describe</u> and <u>compare</u> different characteristics animals have: i) colour ii) size iii) shape iv) body covering etc.	Discuss how they would feel to the touch, how they would move, what they might eat. Chart comparisons and research further. Record information.
	d) <u>Classify</u> animals according to similar characteristics.	Hand out assorted pictures and have students classify, then justify their classification, e.g., birds, fish, farm/zoo, pets, size.
	e) Give reasons for classifying animals or for not accepting an animal into a group.*	If an animal is or is not accepted into a group, give a reason, i.e., frog goes with fish because they like the water, or they don't go together because a fish is scaly or must stay in the water, unlike a frog.
3. Animals require care.	a) <u>Identify</u> animals which require care by humans.**	List pets and other animals requiring care, i.e., farm, zoo. Try to get students to give an overall title to a grouping (pets, zoo animals, farm animals).
	b) <u>Describe</u> and <u>chart</u> how humans care for animals.**	Chart ways in which we care for animals i.e water, food, veterinarian care, conservation.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) <u>Describe</u> and <u>list</u> different occupations related to animals.**	The occupations can include zoo keeper, farmer, veterinarian, conservation officer, Humane Society worker, fisherman, trapper.
	d) <u>Infer</u> that humans have a responsibility to care for all animals, not only pets.**	
	e) <u>Infer</u> that animals require air, sun, food and water.**	Brainstorm ways in which people interfere with these basic requirements and the consequences that may result.
	f) <u>Describe</u> how animals gather into groups to care for each other, i.e., grooming monkeys, wolf packs.	Research care given by animals to each other.
	g) <u>Identify</u> and <u>describe</u> how some animals take care of their offspring.	Discuss how offspring are cared for. Invite a mother with a baby to provide information in parenting.
	h) <u>Identify</u> and <u>infer</u> why some animal's parents do not care for their offspring.	Discuss likes and differences in animals, e.g., mammals vs reptiles.
	i) <u>Record</u> observations of a live animal in the classroom.	<u>SAFETY</u> Check for student allergies. Humane treatment of animals should be shown at all times. Check "Safety in Science," Department of Education, 1982, pp. 70-86.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
4. People need to develop a value regard for living organisms.	a) <u>Develop</u> a positive attitude for living organisms.** b) <u>Infer</u> the reasons for species to be endangered or to have become extinct.***	Use forest fire presentations such as "Smokey the Bear." Discuss that many plant and animal deaths may be caused by humans. The students should realize that living things are a resource that man can use but should not abuse.

GRADE ONE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: PEOPLE ARE LIVING ORGANISMS



GRADE ONE

TITLE: INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: PEOPLE ARE LIVING ORGANISMS

RATIONALE: Through the use of process skills, children will recognize that human beings are living organisms, and that each person is an individual with unique characteristics. Human beings are part of the animal world and share certain characteristics.

MAIN CONCEPT(S): Human beings are living organisms (animals, mammals). There are various similarities and differences among human beings.

Note: This unit integrates well with math units.

- * Refers to problem-solving
- ** Refers to STS
- *** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. People are living organisms (animals/mammals).	a) <u>Chart</u> physical characteristics of people.	Chart students' observations and discuss them. Their observations should include the following characteristics of people: i) breathe ii) move iii) eat iv) have young.
2. People's height varies.	a) <u>Observe</u> and <u>compare</u> the differences in body height. b) <u>Measure</u> and <u>compare</u> , students' heights in non-standard units.	Use such things as paper clips as the non-standard units. Make a chart on graph paper on the wall. Have students see their height using comparisons of each other. A classroom bar graph can also be made so that the upright columns will show the comparisons more clearly.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) <u>Discuss</u> the information shown on a graph.	
3. Heads vary in size.	a) <u>Measure</u> head size in non-standard units.	Have students measure head size using string.
	b) <u>Discuss</u> the information shown on a graph.	Make a class bar graph using the strings which were used for measuring.
4. Eyes vary in colour.	a) <u>Observe</u> and <u>classify</u> different eye colour.	Group the students according to eye color.
5. Ears vary in shape.	a) <u>Observe</u> difference in ear shape.	Have students examine each others ear lobes to determine types; detached and attached.
6. Hair varies in colour.	a) <u>Observe</u> and <u>classify</u> hair color.	Survey the hair colour of class members. Group the students according to hair color. Have each student list his or her hair and eye colour on a card. Place like cards in one pile. Chart results.
7. Feet vary in size.	a) <u>Observe</u> differences in foot shape.	Sprinkle the bare foot with power or flour and step on black paper. Observe foot prints.
	b) <u>Measure</u> foot size in non-standard units.	Trace feet on large graph paper and count the squares.
8. Hands vary in size, shape and strength.	a) <u>Observe</u> differences in hand size.	Trace hands on paper and compare lengths of fingers. Use a clear container of water and mark the water level with tape. Immerse hand and note differences in water level.

ENRICHMENT

Have children trace their hand on large square graph paper and compare the area of the hand with other members of their family.

Do a finger print activity. Observe and compare differences in the prints.

Visit the local police or R.C.M.P. station.

9. People vary in their likes and dislikes. a) Observe that no all people like the same things.
10. Differences and similarities among humans must be valued. a) Develop a regard for the differences and similarities among humans.**

Have student discuss such things as food, TV shows and colours to determine each of their likes and dislikes.

ENRICHMENT

Do a school survey on one of these. Make predictions of results before starting.

RESPONSE QUESTIONNAIRE FOR K-9 SCIENCE PROGRAM OF STUDIES

Please return this questionnaire by January 15, 1992 to the:

Science Consultant
Curriculum Services
Manitoba Education and Training
411-1181 Portage Avenue
Winnipeg, Manitoba R3G 0T3

Please respond to each question in the space provided. (Attach extra sheets if more space is required). Use the page references when making specific comments.

1. Does the guide provide you with sufficient information as to nature and scope of the science program?

2. Are you able to adequately cover the stated objectives within the available class time?

3. Are your students capable of achieving the objectives listed in the unit(s)?

4. Is there sufficient variety in the activities to allow all students to take part in the program?

5. Which activities are too simple or too difficult for the intended grade level?

6. Which activities do not seem to work well?

...../2

7. Which activities require clearer directions?

8. Are there sufficient material resources in your school to enable you to adequately teach the program?

9. Is there difficulty in obtaining science materials in order to carry out the activities?

10. Do the students enjoy or appreciate the program?

11. What are some specific features of the program with which you are pleased?

12. Within the framework of the revised program, please make suggestions which, in your opinion, may result in significant improvements.

NAME: _____ SCHOOL: _____

GRADE: _____ PHONE: _____

THANK YOU FOR YOUR ASSISTANCE.